

PCDDs AND PCDFs IN THE BLOOD OF WORKERS AND RESIDENTS OF INDUSTRIAL AREA IN KOREA

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Introduction

The incineration of hazardous waste is thought to be an important potential source of PCDDs/PCDFs chemicals in the environment. The PCDDs/PCDFs in the incinerator waste such as ash and emission gas may be bioavailable and contribute to human body burdens of these compounds. In our previous study, we investigated concentration and distribution of PCDDs/PCDFs in breast milk of mothers living nearby the municipal incinerator and found slightly higher TEQ levels(pg/g fat basis) of these compounds than those of mothers in the USA(Shin DC, et al., 1999).

In this report, we describe the results of study in which serum levels of PCDDs/PCDFs in a group of workers at a hazardous waste incinerators were compared to those in a comparison group of community residents who had never worked at the incinerators.

Materials and Methods

Two cohorts were selected for this study. The first cohort was a group of 10 employees at a hazard waste incinerators. They were 35 (23 – 47) years of age and 4.7 (1 – 15) years of working in hazard waste incineration. And the Second cohort was a group of 10 community residents living in the industrial area including the hazard waste incinerators. They were 38 (32 – 42) years of age and had lived in study area of at least 3 years.

Blood was collected without anticoagulant, centrifuged to remove cells, and frozen. It was delivered to the Fisheries & Oceans Lab. of Canada and the School of Environmental Engineering at Pohang University. Quantitative assessment of PCDDs/PCDFs and PCBs in blood was analyzed by HRGC/HRMS. The Fisheries & Oceans Lab. of Canada is international certified laboratory for analysis of dioxins in human tissue and cooperated with our laboratory in interlaboratory validation program.

Calculation of PCDDs/PCDFs body burden was made according to a subject's body weight and percentage of body fat(Schechter et al., 1998). The equation used for calculating body burden was :

$$\text{Body Burden (TEQ ng)} = C_{\text{blood}}(\text{TEQ ng/kg lipid}) * BW_{\text{subject}}(\text{kg}) * f_l$$

where C_{blood} (TEQ ng/kg fat) : Concentration in blood

BW_{subject} (kg) : Body weight of subject

f_l : Proportion of subject's body fat(Knapik et al., 1983)

male : $f_{l_{\text{male}}} = 1.264 * [\text{weight}(\text{kg})/\text{height}^2(\text{m}^2)] - 13.305$

female : $f_{l_{\text{female}}} = 1.030 * [\text{weight}(\text{kg})/\text{height}^{1.5}(\text{m}^{1.5})] - 0.835$

Results and discussion

The results in dioxin concentration are shown in Table 1 and Figure 1. PCDDs/PCDFs levels in blood of smokers showed higher average concentration than those of non-smokers. Dioxin levels in blood of workers were higher than those of residents. The detection ranges of dioxin in non-smokers were 7.91 – 33.90 pg/g lipid and 15.04 – 65.18 pg/g lipid for residents and workers, respectively. For PCBs, smokers were slightly higher than non-smokers for both residents and workers. For PCBs

levels of non-smokers, the average level of residents was similar to workers. For PCDDs/PCDFs, HxCDD/HxCDF(above 40%) and PeCDD/PeCDF(above 30%) were the predominant congener, and the proportion of 2,3,7,8-TCDD was less than 10%(non-smoking residents : 1%, non-smoking workers : 8%)(Figure 2(a)). For PCBs, the proportion of PCB-126(above 50%) was the highest and the that of PCB-156 was about 15%(Figure 2 (b)). The body burden levels based on the concentration of dioxin-like compounds in blood were 1.61-10.36 ng/kg for PCDDs/PCDFs and 0.58-3.12 ng/kg for PCBs(Figure 3). The average levels of body burden were found to be lower than those of adult in the USA(about 9 ng/kg)(Birbaum et al., 1997). The compared level of PCDDs, PCDFs, and PCBs in blood among several countries is shown in Figure 5. The average concentrations of non-smoking residents in this study were similar to Japanese women(Iida, et al., 1999) and Canadian(Ayotte, et al., 1999), and PCDDs/PCDFs level of non-smoking residents in this study was about 1/2 times of that of North American(Schechter, et al., 1998). For the high exposure group, the levels of non-smoking workers in this study were slightly higher than those of pulp and paper mill workers in USA(Tepper, et al., 1997) and those of adults in the pesticide spray area in China(Schechter, et al., 1996), but lower than those of high exposure group of Canadian(Ayotte, et al., 1999) and Swedish herbicide workers(Littorin, et al., 1994). The PCDDs/PCDFs level of incinerator workers in the study was similar to that of incinerator workers in Germany(Schechter, et al., 1995).

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Table 1. PCDDs, PCDFs and PCBs concentrations in blood in Korea (unit : pg/g lipid)

	Non-smoker						Smoker					
	Residents (n=9)			Workers (n=6)			Residents (n=1)			Workers (n=4)		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
PCDDs	9.05	7.62	4.35-28.75	15.11	7.13	7.53-26.58	6.87	-	-	31.87	22.80	9.74-55.64
PCDFs	6.96	2.68	3.56-13.20	18.59	15.69	6.37-38.68	15.30	-	-	18.25	8.71	5.84-25.66
Dioxin	16.01	7.46	7.91-33.90	33.70	22.00	15.04-65.18	22.16	-	-	50.12	28.58	15.58-74.61
Non-ortho PCBs	4.98	1.39	3.66-7.98	5.21	2.74	2.41-9.38	3.11	-	-	4.50	1.63	2.72-6.45
Mono-ortho PCBs	2.44	1.59	1.24-6.57	2.25	0.98	1.26-4.00	2.17	-	-	2.62	1.30	1.40-4.39
PCBs	7.42	2.22	5.46-12.20	7.46	3.68	3.67-13.38	5.29	-	-	7.11	2.61	4.68-10.38

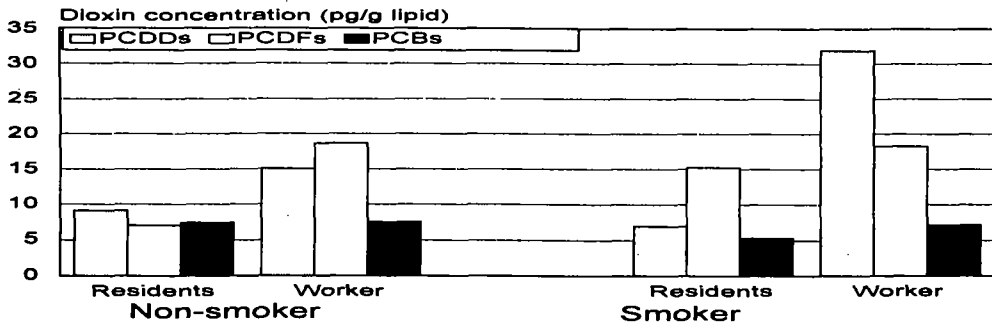
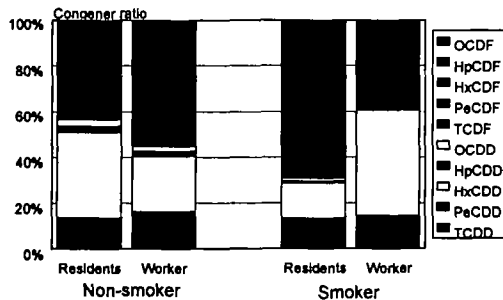


figure 1. Comparison of PCDDs/PCDFs and PCBs levels in blood by exposure group

(a) PCDDs/PCDFs



(b) PCBs

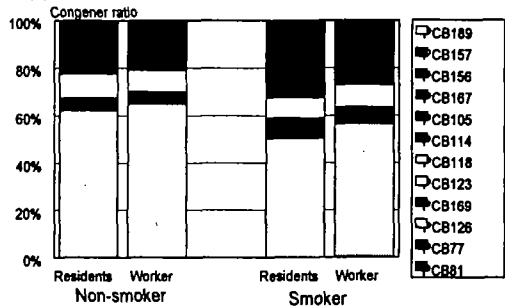


Figure 2. Proportion of PCDDs/PCDFs and PCBs congener in blood by exposure group

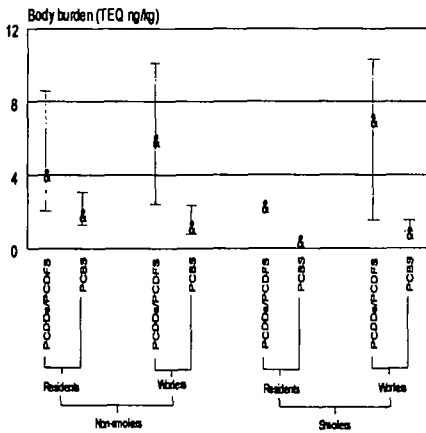


Figure 3. Comparison of body burden of PCDDs/PCDFs and PCBs based on subject's concentration in blood

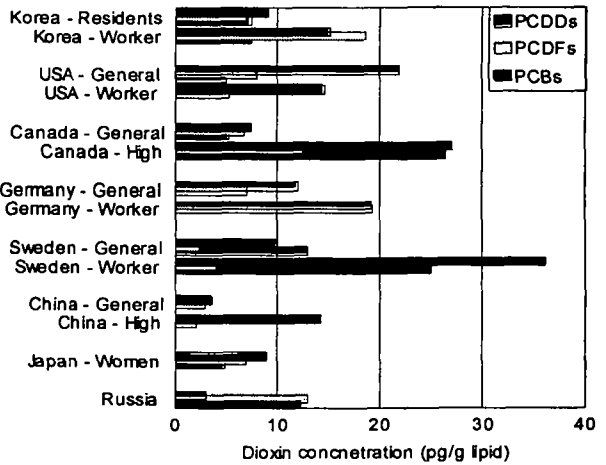


Figure 4. Comparison of PCDDs/PCDFs and PCBs levels in blood